

from 4.31 p. m. to 5.04 p. m. Hail, size and shape of a pea, fell for thirty seconds previous to the rain. The highest wind, lasting five minutes, was twenty-four miles per hour. Direction of wind before storm, northeast; after, southeast. Temperature before storm, 85°; after, 71°. During the storm the low clouds had a whirling motion, branches were broken and grain was prostrated. On July 20th, at 4.48 a. m., one of the most violent thunderstorms, consisting of rapid lightning flashes and peal on peal of thunder, broke on the station. It lasted three hours, and was most severe from 5.40 to 6.15. Rain (1.00 inch) began at 4.19, falling in torrents till 8.15, and ending at 9.15 a. m. No hail; light wind, east and south; temperature before, 64°·5; after, 68°.

CHART OF ELECTROMETER READINGS.

[By Prof. T. C. MENDENHALL, Assistant.]

The first diagram of chart vi shows the results of a set of observations made on the top of the Washington Monument. The elevation of the collector is about five hundred and five feet above the ground. The observations were taken every five minutes, except between 11.30 a. m. and 12 m., and between 1.30 and 2 p. m., when the interval was one minute. The day was cloudless but hazy, the wind from the southwest and light. During the forenoon the needle oscillated almost continually, indicating variable, high, positive potentials. During the afternoon the indications were much less in value, and more regular in character, the weather remaining, however, apparently the same. About 12.30 p. m. there was a period of about eight minutes during which the needle was again very active, after which the indications became again of less value and less variable.

The second diagram of chart vi represents the values obtained at the Sloane Laboratory, Yale College, during the passage of a thunder-storm, July 14, 1886. Thunder was first heard at 6.45 p. m.; loudest from 7 to 7.05 p. m., and last heard at 7.15 p. m. The wind, before the storm, was from the east, velocity about twelve miles an hour; during the storm from the east and southeast, and after the storm from the east. Rain began at 6.54 p. m. and ended at 8.30 p. m. Lightning was recorded at 7.02 and 7.07 p. m.

The following notes are abstracted from the report of the observer at that station:

Negative potentials occurred on the following dates: June 23d, heavy rain and east wind. June 30th, at 1 p. m., very slight indications, weather clear, wind south. July 3d, 11 a. m., very slight indications, weather clear, wind northwest. July 9th, 9 a. m., wind northeast, light rain; 3 p. m., wind south, light rain. July 12th, 1 p. m., slight indications, weather clear, wind south. July 16th, throughout the day large values, continued rain. July 21st, at 11 a. m., light rain, southeast wind. July 27th, at 11 a. m., large values, heavy rain. All days on which rain fell were characterized by negative potentials. A faint auroral display observed at 2 a. m., June 30th; was preceded, during the afternoon of the 29th, by negative potential.

At Boston, Massachusetts, on July 27th, the electrometer gave evidence of unusual disturbance, and special readings were made at intervals of two minutes from 9 a. m. until 11 a. m.

The following abbreviated table is from the observer's record:

Time.	Volts.	Remarks.	Time.	Volts.	Remarks.
<i>A. M.</i>			<i>P. M.</i>		
9.00	— 10	Threatening.	2.00	+ 25	Light rain.
9.02	— 8		2.06	+150	
9.04	0		2.08	+ 60	Heavy rain.
9.08	+ 8	Light showers.	2.10	+400	
9.10	+ 14		2.12	— 95	
9.12	— 40	Rain ended.	2.14	+360	
9.20	— 12		2.16	—180	Light rain.
9.30	0		2.18	— 60	
9.38	+ 20		2.20	— 5	
9.40	0		2.22	+ 40	Heavy rain.
9.46	+ 40		2.24	+ 65	
9.50	— 16		2.26	+ 25	
10.00	— 20		2.28	+ 48	
10.10	— 5		2.30	+ 22	Light rain.
10.18	+ 20	Light rain began.			
10.28	— 20				
10.30	+ 15				
10.40	+ 5				

There was a very brilliant aurora during the night of July 27th. At 6.40 a. m. July 28th the potential exceeded 1,100 volts. From 7 a. m. until 8.15 a. m. the mean potential of the air exceeded 1,000 volts. At 9 a. m. it averaged about 265. It continued falling steadily. At 11 a. m. it was zero, and at 1 p. m., minus ten, where it remained during the rest of the day.

The third diagram of chart vi represents the potential variations during a thunder-storm at Cornell University, Ithaca, New York. The observations, in detail, are given below:

During the month negative readings occurred on the following dates: July 7th, at 9 a. m., in value about 16 volts, the weather hazy, the wind northwest and fresh; low positive potentials during the rest of the day, the weather remaining cloudy and threatening. July 14th, at 11 a. m., mean value 220 volts, weather cloudy, and at times raining. At 1 p. m., 1,425 volts, and a minute later 670 volts, changing to positive 400 at 1.02 p. m., 500 at 1.03, and zero at 1.04 p. m. July 17th, during the forenoon, slight negative values, becoming greater; weather clear and warm, with light haze. July 18th, at noon, during thunder-storm; 3 p. m., 3,250 volts during thunder-storm. July 20th, at 11 a. m., slightly negative for a few moments. July 28th, at 9 a. m., weather clear, calm, and hazy. Rain occurred on July 14th, during the night of the 15th, on the 17th, 18th, 21st, 25th, and 26th.

During the thunder-storm of July 14th the following observations were made:

Time.	Volts.	Remarks.	Time.	Volts.	Remarks.
<i>A. M.</i>			<i>A. M.</i>		
10.57	+ 850	Rain commenced.	11.37	+ 125	
11.03	— 300	Rain increasing.	11.38	+ 225	
11.13	+ 350		11.40	+ 300	
11.17	0	Rain diminishing.	11.42	+ 120	
11.18	— 125		11.44	— 80	
11.19	— 125		11.46	— 170	
11.20	+ 50	Rain increasing.	11.48	— 85	
11.21	+ 375		11.50	— 150	Rain increasing.
11.22	+1300	Very heavy rain.	11.51	— 300	
11.23	+1550		11.52	0	
11.25	+1400	Rain diminishing.	11.53	+ 270	
11.26	+1300		11.54	+ 125	
11.28	+1600		11.55	— 150	
11.30	+1000	Rain diminishing.	11.56	— 200	
11.31	+ 700		11.58	— 175	
11.32	+ 250		12.00 m.	— 180	
11.33	+ 25		1.00 p. m.	—1425	High southeast wind, light rain.
11.34	— 50	Light rain.	1.05 p. m.	+ 10	
11.35	— 25		3.00 p. m.	+ 45	
11.36	+ 25				

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos were observed in the various states and territories during the month, as follows:

Alabama.—Mobile, 10th.
Arizona.—Yuma, 12th, 20th.
Connecticut.—New Haven, 2d; New London, 29th.
Dakota.—Webster, 30th.
Florida.—Sanford, 1st, 5th; Key West, 1st, 8th, 9th.
Georgia.—Augusta, 2d; Savannah, 11th.
Illinois.—Pekin, 1st to 5th, 7th, 8th, 10th, 12th, 20th, 24th, 25th, 27th.
Indiana.—Jeffersonville, 13th, 16th.
Iowa.—Keokuk, 23d.
Kansas.—Wyandotte, 20th, 21st, 22d; Salina, 27th; Yates Centre, 30th.
Maine.—Cornish, 9th, 14th, 21st; Portland, 9th, 21st; Gardiner, 21st.
Massachusetts.—Milton, 5th, 18th, 25th; Heath, 19th; Provincetown, 25th, 26th, 28th, 29th, 30th.
Michigan.—Escanaba, 8th; Marquette, 8th, 29th; Grand Haven, 11th.
New Hampshire.—Mount Washington, 25th.
New Jersey.—Clayton, 1st, 15th; Beverly, 13th.
New York.—Mountainville, 1st; Setauket, 1st, 2d; Palermo, 2d.
North Carolina.—New River Inlet, 9th, 15th, 18th, 25th.
Ohio.—Wauseon, 2d, 25th, 29th.
Oregon.—Roseburg, 4th, 26th; East Portland, 6th.

Pennsylvania.—Philadelphia, 1st; East Brook, 1st, 28th; Dyberry, 2d; Wellsborough, 14th, 26th.

South Carolina.—Stateburg, 2d, 20th, 21st; Spartanburg, 14th.

Tennessee.—Nashville, 24th, 31st.

Texas.—Galveston, 12th, 13th, 19th, 22d.

Vermont.—Lunenburg, 7th; Poultney, 9th; Strafford, 29th.

Virginia.—Lynchburg, 4th, 21st, 27th; Variety Mills, 15th; Dale Enterprise, 26th, 29th.

Washington Territory.—Bainbridge Island, 31st.

Wisconsin.—Milwaukee, 27th.

Wyoming.—Fort Bridger, 11th, 21st, 24th.

LUNAR HALOS.

Lunar halos were observed in the various states and territories during the month, as follows:

Alabama.—Montgomery, 8th, 9th.

Arizona.—Willcox, 16th.

California.—Sacramento, 12th.

Colorado.—Pike's Peak, 14th.

Connecticut.—New London, 17th.

Florida.—Key West, 7th, 8th, 10th; Sanford, 9th, 16th; Jacksonville, 10th, 12th; Limona, 17th.

Georgia.—Atlanta, 6th; Augusta, 10th, 12th; Savannah, 11th.

Illinois.—Pekin and Springfield, 9th.

Indiana.—Jeffersonville, 9th, 10th, 11th, 13th; Vevay, 10th, 13th; Terre Haute, 12th.

Kansas.—Wyandotte, 7th, 8th; El Dorado, 7th, 22d.

Kentucky.—Frankfort, 10th, 12th; Louisville, 11th.

Louisiana.—New Orleans, 10th, 13th.

Maine.—Portland, 9th, 25th.

Massachusetts.—Boston, 21st, 25th.

Michigan.—Lansing, 8th.

Nebraska.—North Platte, 9th, 11th; De Soto, 13th.

New Hampshire.—Nashua, 9th, 21st, 25th.

New York.—Setauket, 8th.

North Carolina.—New River Inlet, 13th; Kitty Hawk, 17th.

Ohio.—Tiffin, 8th; Cincinnati, 12th; Garrettsville, 24th.

Oregon.—East Portland, 17th.

South Carolina.—Spartanburg, 13th.

Tennessee.—Knoxville, 7th, 8th; Nashville, 12th, 18th, 19th.

Texas.—Palestine, 6th, 9th, 16th; Indianola, 7th, 8th, 11th, 13th to 18th; Brownsville, 9th; San Antonio, 13th.

Utah.—Frisco, 17th.

Virginia.—Bird's Nest, 6th, 7th, 12th, 13th; Wytheville and Dale Enterprise, 9th; Rappahannock Station, 9th, 11th; Lynchburg, 10th, 13th, 14th; Variety Mills, 11th.

West Virginia.—Clarksburg, 7th; Parkersburg, 7th, 13th.

Wyoming.—Fort Bridger, 10th, 15th.

The phases of the moon (Washington mean time) during July, as given in "The American Ephemeris and Nautical Almanac" for 1886, are as follows: New moon, 1st, 4 h. 58.4 m., and 30th, 12 h. 17.7 m.; first quarter, 7th, 20 h. 9.9 m.; full moon, 15th, 10 h. 0.7 m.; last quarter, 23d, 14 h. 13.1 m.; apogee, 18th, 13.6 h.; perigee, 3d, 0.0 h., and 31st, 5.9 h.

MIRAGE.

Indianola, Texas, 12th, 13th.

Oswego, New York, 22d.

Duluth, Minnesota, 9th.

Webster, Dakota, 6th.

Salina, Kansas, 27th.

Reidsville, North Carolina, 30th.

MISCELLANEOUS PHENOMENA.

DROUGHT.

During July a very disastrous drought prevailed over Iowa, Illinois, Dakota, and Minnesota, as well as over the greater part of Wisconsin, Nebraska, Kansas, and Texas. The dry weather commenced in May, and during June and July had become a severe drought, inflicting large losses on the grain-growing interests in the Northwest and the cattlemen in Texas.

During the first six days of the month very high temperatures occurred in the northern districts, especially in Dakota on the 6th, which added materially to the injurious effects of the dry weather. In New England also the effect of dry weather could be seen in the brown dry grass and short crops. All the rivers were low, especially the Connecticut and Merrimac, while a number of their tributaries had become nearly dry. Along the valleys of both these rivers a number of mills were obliged to suspend operations on account of the low water, and many persons were thrown out of employment. The following notes will serve to show the extent and severity of the drought:

Aberdeen, Brown county, Dakota, 4th: hot winds and unusually warm weather have prevailed in this vicinity for the past week, doing much damage to wheat. Farmers estimate that the yield will not be more than half the average crop, as very little rain has fallen during the past month.

Freeport, Stephenson county, Illinois, 6th: drought has prevailed in this vicinity during the past six weeks, and the ground has become very hard and dry. The growing crops are being stunted, and pasture land is becoming bare.

Huron, Dakota, 6th: the ground is quite dry, and grain and grass are suffering from the effects of the long continued dry weather.

Fort Worth, Texas, 7th: reports from various parts of the surrounding country state that the effects of the long drought in western Texas is unprecedented, in some localities no heavy rains have fallen during the past fourteen months.

Galena, Illinois: on the 9th the long-continued and disastrous drought in this section was broken by a rain, which thoroughly wet the ground and greatly benefited vegetation of every kind.

Albany, Shackelford county, Texas: on the 12th the northern part of Texas was visited by a heavy rain storm, which was of great benefit to farmers and cattlemen. During May, June, and the first decade of July very little rain had fallen, and the ground had become cracked and baked hard by the sun. Crops of all kinds, including grass on cattle ranges, were dead and dry. Cattle were reported to have been dying rapidly from lack of water and food.

Cedar Rapids, Iowa, 13th: reports from various points in Iowa show that crops will be short on account of the prevailing drought.

Bangor, Maine, 14th: drought in this section of the state has affected the hay crop, and only two thirds of the average yield will be secured. In Washington and Hancock counties as well as in various other parts of Maine, the injury has been greater and numerous wells and springs have become exhausted, while rivers as large as the Penobscot became so low as to interrupt logging operations. On the Mattawamkeag River 5,000,000 feet of logs were grounded.

Boston, Massachusetts, 15th: reports from the various farming districts of the state show that the crops are suffering severely from the effects of the drought. In Newburyport and along the Merrimac Valley thousands of acres of potatoes and corn are injured. The drought has inflicted severe losses on the Cape Cod cranberry farmers.

Grand Haven, Michigan, 15th: farmers say that the long continued dry weather has dried and killed the grass in pastures, and that the potato crop will be a complete failure.

Carson, Pottawattomie county, Iowa, 16th: drought has prevailed here during the past six weeks, and corn and other crops are suffering.

Dallas, Texas, 17th: the drought in western Texas has become very severe; cattle are dying from want of water and grass; stockmen are moving their herds into those counties that have not been so seriously affected.

Shawneetown, Gallatin county, Illinois, 20th: copious rain fell to-day, doing a great amount of good to corn, which had commenced to suffer from the drought.

Cape Girardeau, Cape Girardeau county, Missouri: this place was visited by a heavy fall of rain on the afternoon of the 20th, which was of great benefit to crops, no rain having fallen dur-